NASA SCIENCE MISSION DIRECTORATE

Earth-Sun System Applied Sciences Program
Invasive Species Program Element
FY2006-2010 Plan

Version: FINAL DRAFT

Date: 6/30/2006

Expanding and accelerating the realization of economic and societal benefits from Earth-Sun System science, information, and technology

NASA Science Mission Directorate
Earth-Sun System Division
Applied Sciences Program

Applied Sciences for the Invasive Species Program Element:

This document contains the Invasive Species Program Element Plan for FY 2006-2010.
This plan derives from direction established in the NASA Strategic Plan, Earth Science Enterprise and Space Science Enterprise Strategies, Earth Science Applications Plan, and OMB/OSTP guidance on research and development. The plan aligns with and serves the commitments established in the NASA Integrated Budget and Performance Document.

The Program Manager and the Applied Sciences Program Leadership have reviewed the plan and agree that the plan appropriately reflects the goals, objectives, and activities for the Program Element to serve the Applied Sciences Program, Earth-Sun System Division, NASA, the Administration, and Society.

(Signature on file) _____ _____
Ed Sheffner Date
Program Manager, Invasive Species
Applied Sciences Program
NASA Earth-Sun System Division

(Signature on file) _____ _____
Lawrence Friedl Date
Lead, National Applications
Applied Sciences Program
NASA Earth-Sun System Division

(Signature on file) _____ _____
Ronald J. Birk Date
Director, Applied Sciences Program
NASA Earth-Sun System Division

NASA Earth-Sun System Division: Applied Sciences Program

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Invasive Species Program Element Plan: FY 2006 - 2010

I. Purpose and Scope

This Applied Sciences National Applications Program Element Plan is applicable for Fiscal Years 2006 through 2010. The plan documents the purpose of the program and the implementation approach to meet the program objectives using the allocated resources. The plan describes the program element approach in extending NASA Earth-Sun system science research results to meet the decision support requirements of partner agencies and organizations. The Applied Sciences Program requires this plan to function as a program management tool, describing the program structure, functional mechanisms, performance measures, and general principles that will be followed in extending NASA research results for societal benefits.

Scope within NASA and Applied Sciences Program

Each National Applications Program Element is managed in accordance with, and is guided by, the NASA Strategic Plan and Earth Science Applications Plan. The program element benefits from NASA Earth-Sun system science research results and capabilities, including the fleet of NASA research satellites, the predictive capability of models in the Earth System Modeling Framework (ESMF), Project Columbia, the Joint Center for Satellite Data Assimilation (JCSDA), and the Earth-Sun System Gateway (ESG). The Applied Sciences Program seeks to develop with its partners scientifically credible integrated system solutions in which uncertainty characterization and risk mitigation has been performed using the capability of the national Earth-Sun laboratories and others in the community of practice.

The FY06 President's Budget for the NASA Applied Sciences Program specifies between $48 million and $55 million annually for FY06 – FY10. There are two elements to the Applied Sciences Program: National Applications and Crosscutting Solutions. Each National Applications Program Element benefits from the performance results of Crosscutting Solutions (see Crosscutting Solutions Program Element Plan). Each National Applications Program Element leverages and extends research results from the over $2 billion per year supporting Earth-Sun system science and development of innovative aerospace science and technology. Additional information about the NASA Applied Sciences Program can be found at http://science.hq.nasa.gov/earth-sun/applications.

Management and control of invasive species is a major national concern. The annual cost to management agencies in the United States, at all levels of government, to control invasive species well exceeds $100 billion per year, and is likely to grow. Eradication is no longer an option for species that have become endemic in certain areas. A current objective for control agencies is to predict sites where an invasive species is likely to venture and to reduce the spread of the species by eradicating it from new sites before the species is well established and while eradication costs remain reasonable. The invasive species program element seeks partnerships with agencies that have mandates to control invasive species and that can use NASA Earth science observations, measurements,

model output and systems engineering to improve prediction of the spread of invasives and manage the response. The collaboration among NASA, the Department of the Interior (DOI – especially United States Geological Survey (USGS)), the US Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA) on invasive species is illustrative of the integrated systems solutions that the Applied Sciences Program seeks with its partners (see Appendix A). The spread of invasive species is increasing as global travel and shipping expands the opportunity for movement of organisms. The issue has developed diverse stakeholder support, ranging from state and federal land management agencies, the agricultural and recreational industries, conservation organizations, and private landowner groups. The National Research Council's Committee on Grand Challenges in Environmental Sciences has identified increased understanding of biodiversity and ecosystem functioning as one of eight "Grand Challenges in Environmental Science" facing our nation and the world today. The committee emphasized the need for developing an ecological forecasting capability and improved management techniques for non-indigenous species. Within the Earth-Sun System Division, the invasive species and ecological forecasting program elements are closely aligned, share information on modeling, and collaborate on writing and implementation of solicitations.

II. Goals and Objectives

Goals

The long term goal of the Invasive Species Program Element is the integration of NASA Earth- Sun system observations, modeling and systems engineering capabilities into the operational procedures of federal agencies and other organizations with mandates to respond to the incursion and spread of invasive species in terrestrial and aquatic habitats. This goal is manifest in the integration of observations sponsored by the Earth–Sun System Division, modeling and systems engineering in the National Invasive Species Forecasting System (NISFS). The USGS is the lead agency developing the NISFS on behalf of the National Invasive Species Council (NISC). The primary outcome of this effort is a dynamic, flexible NISFS that allows scientists and resource managers to integrate climate, weather, hazard and land cover parameters to model and analyze regional-scale biological resources. The information products produced by the system are electronic and printed maps of potential hot spots of native plant diversity, including:

(1) probable locations of rare habitats;
(2) probable locations of relict/unique species assemblages;
(3) potential areas of future invasion;
(4) spatial auto-correlations with cross-correlation statistics for single exotic species;
(5) accuracy assessments of native and exotic plant diversity;
(6) evaluation levels of uncertainty in maps of natural resources; and,
(7) classification and regression trees for map accuracy.

These products are critical elements of an invasive species DSS. The Invasive Species Program Element overlaps with research and technology activities in the Earth-Sun System Division. Research tasks in land cover/land use change, carbon cycle science and ecological forecasting, and technology tasks in advanced computation contribute to the development of capabilities that are implemented through the Invasive Species Program Element. For example, the Earth-Sun System Science Technology Office, through a competitive solicitation, sponsors development of new parallel processing techniques suitable for the computational requirements of the NISFS. The transition of NASA capabilities for the NISFS to the operational user (USFS) will continue in FY06. In addition, the invasive species program element will seek new projects that evaluate other NASA data sources and engage

new members of the community in partnerships with NASA the enhance their decision making tools.

Objectives

All National Applications Program Elements are aligned to the NASA Strategic Plan and the agency's objectives as expressed in the NASA Integrated Budget and Performance Document (IBPD) and the Performance Assessment Rating Tool (PART).
Objectives: FY06 projects:

1. GSFC: Invasive Species Forecasting System and related activities
   a. Deliver releases 3 and 4 to the ISFS
   b. Assist in early adaptor sessions for the ISFS operational transfer plan
   c. Enhance the ISFS/ISAMS with regression and co-kriging approaches. Verify and validate results.
   d. Integrate National Park Service (NPS) and Yellowstone Ecological Research Center projects into the ISFS
   e. Benchmark enhancements to the ISFS

2. CSUMB: National Park Service (Yellowstone) decisions support tool for wildlife management and data visualization
   a. Verification and validation of interactive visualization products for use by YNP staff and visitor information centers
   b. Transfer data and data visualizations to ORNL DAAC

3. GSFC: National Park Service Decisions on Fire Management and Invasive Plant Species Control
   a. Evaluation of current NPS decision making tools
   b. Complete inventories of capabilities at each of three park sites
   c. Develop baseline data and burnt area data

Other programmatic objectives in FY06:

1. Initiation of at least one new, invasive species-specific project (e.g., tamarisk, yellow starthistle) with the USDA and DOI.
2. Documentation of Invasive Species Program Element in appropriate journal and participation in at least one national /international conference, e.g., International Geoscience and Remote Sensing Symposium (9/04).
3. Represent NASA on the National Invasive Species Council and associated groups
4. Examine the impact of observations from new NASA systems (e.g., OCO, and Aquarius) on climate and weather predictions and the impact of those predictions on invasive species decision support systems and tools.

III. Program Management and Partners

A. Program Management

Program Manager,
Invasive Species Program Element

Mr. Ed Sheffner
Earth-Sun System Division
Applied Sciences Program
NASA Headquarters Washington DC

Responsibilities:

- Development of and implementation of interagency agreements and partnerships with other organizations
- Program development including program plans and budgets
- Development and implementation of solicitations for Invasive Species tasks
- Primary responsibility for metrics, performance goals and other performance evaluation criteria
- NASA representative to the National Invasive Species Council and associated committees.
- Monitor projects within the program element and collaborate with the principal investigators and the invasive species control community to assure that the goals and objectives of the program element are responsive to community needs and goals and objectives of the Applied Sciences Program.

Deputy Program Manager,
Invasive Species Program Element
Mr. Rodney McKellip
Project Research Scientist
Applied Sciences Directorate
Stennis Space Center, MS (SSC)

Responsibilities:

- COTR or Studies Manager (as appropriate) for grants and cooperative agreements that address Invasive Species management and are funded through procurement at SSC
- Coordination of activities among the program element team members including the NASA Centers
- Monitor the progress of projects within the program element. First point of contact for principal investigators within the program element.

B. Invasive Species Network & Partners

NASA Centers:

1. Ames Research Center: Decision support tools for tamarisk and other invasive plants (Dr. David Bubenheim)
2. Goddard Space Flight Center: Program element scientist, computational research for NISFS (Dr. John Schnase)
3. Stennis Space Center: Program Element Management (Mr. Rodney McKellip)

Government agencies and programs:

1. Department of Agriculture: Agricultural Research Service, Cooperative State Research Education and Economics Service, Natural Resources Conservation Service, Farm Services Agency (Dr. Ernest Delfosse)
2. Department of the Interior: Memorandum of Understanding with NASA (Mr. Gordon Brown)
3. Department of the Interior: US Geological Survey (especially the National Institute for Invasive Species Science); National Park Service (Dr. Tom Stohlgren)

4. Department of the Interior: National Park Service (Dr. Patrick White)

Universities (current active contacts):

1. Mississippi State University: DSS for aquatic invasive plants (Dr. Lori Bruce)
2. University of Arizona: Tamarisk decision support tools (Dr. Edward Glenn)
3. California State University Monterey Bay: Decision support tools for National Park Service (Dr. Fred Watson)
4. Montana State University
5. Yellowstone Ecological Research Center
6. Idaho State University
7. Desert Research Institute
8. Colorado State University
9. South Dakota State University

Other organizations:

1. Bonneville County, ID: Implementation of decision support tools at the local level (Mr. Jeff Pettingill)

DAACS and Earth Science Modeling Center Partners:

ORNL DAAC

IV. Decision Support Tools and Management Issues

Priority Decision Support Tools

National Invasive Species Forecasting System (NIFS)

The NISFS is the primary decision support tool within the NIISS. Benchmarking the performance of the tool against USGS requirements is an objective for FY05. In FY06 and beyond, the tool will be benchmarked against the requirements of other USGS client organizations as part of the business plan for the NIISS.

Potential Invasive Species Management Issues: FY06-FY10

None.

Cross-Application Activities

The program consists of functional elements that contribute to all of the National Applications activities. The intention is to have the performance of these functions leverage accomplishments, and therefore the apparent resource investment, to the greatest extent possible into the National Applications partnerships. These functions are: Geoscience Standards and Interoperability, Human Capital Development, Integrated Benchmark Systems, and Solutions Networks. Examples of leveraged activities are:

- The Earth-Sun System Gateway is a "portal of portals" providing an access point through an Internet interface to all web-enabled NASA research results.
- A Solutions Networks capability to discover candidate configurations of NASA research results with the potential to improve partner's decision support systems.
- A Rapid Prototyping Capability to support NASA and partners in reducing uncertainty and testing the validity of NASA research results in decision support tools.
- Systems integration capability, knowledge tools and skilled human capital to help conduct studies on the systematic transitioning of the results of research to operational uses and the capability of operational systems to support scientific research.
- A student-based, human capital development program for building capability in entry level participants in the community of practice while developing solutions for state and local applications.

V. Application Activities

A. Projects

All National Applications Program Elements authorize peer-reviewed projects to support each element's goal and objectives. To secure funding and authorization to undertake activities supporting NASA and the Applied Sciences Program, project teams are responsible for developing project plans and managing the activities. The project plans specify the Earth-Sun observations, models, and other research results to extend to decision support tools as well as the activities to produce appropriate deliverables. The plans integrate contributions from appropriate the partners, NASA Centers and other contributors from the community of practice. Projects are expected to extend the benefits of NASA research results to the maximum extent possible, including the use observations from sensors on: Aura, Terra, Aqua, TRMM, NPP, NPOESS, Hydros, Topex, Jason, OCO and Aquarius.

B. Solicitations

The Applied Sciences Program utilizes full and open competitions to fund proposals from the community to contribute the Agency's objectives. This implementation strategy will continue to be critical part of extending the benefits of NASA Earth-Sun system research results and contributing to the improvement of future operational systems. The Program has participated in providing opportunities to the community in recent solicitations, including REASoN, Decisions 2004, and Decisions under ROSES. The proposals related to this National Applications Program Element that have been funded under these solicitations are described in Section V.D. Program Element Projects.

C. Congressionally Directed Activities

As of the publication of this document, an assignment of FY06 congressionally mandated activities was not completed by the Agency.

The procurement rules and management practices of the Agency require that congressionally mandated activities follow the same principles of planning and accountability as all other funded projects. Only activities that are aligned with NASA's mission, are technically credible, and are appropriately budgeted will be approved to receive funding from the Program. The project teams of congressionally mandated activities are responsible for developing project plans and managing the activities.

D. Program Element Projects

Included below are the brief descriptions of the funded projects managed under this National Applications Program Element. Complete and detailed descriptions are documented in the Project Plans for each activity.

Project: CABI Invasive Species Compendium

Participate in the compilation of an on-line compendium of information on invasive species inthe United States. The project is a collaboration with other US agencies, especially USDA.

Budget ($K)

Procurement

FY06	95
FY07	
FY08	
FY09	
FY10	

Project Manager	*Centers*	*Timeframe*	*Partners*
Ed Sheffner		FY06 - FY06	USDA

Earth Science Products

Other Apps.

Deliverables

Description	*End Date*	*IBPD Metric #*
Evaluation Report		
Design & Implement		
Verification and Validation Report		
Benchmark Report		

Notes:

Project: Modeling Workshop with Ecological Forecasting and Public Health

Follow-on to joint modeling workhop held in Asilomar, CA in the spring of 2005. This workshop will produce a series of articles on coomon modeling approaches that will benefit at least three national application areas.

Budget ($K)

Procurement

FY06	40
FY07	
FY08	
FY09	
FY10	

Project Manager	*Centers*	*Timeframe*	*Partners*
Ed Sheffner	ARC (lead), GSFC, SSC, GISS	FY06 - FY06	

Earth Science Products

Other Apps.

Deliverables

Description	*End Date*	*IBPD Metric #*
Evaluation Report		
Design & Implement		
Verification and Validation Report		
Benchmark Report		

Notes:

Project: NPS Yellowstone DST

Augmentation to existing award

Budget ($K)

Procurement

FY06	38
FY07	200
FY08	
FY09	
FY10	

Project Manager	*Centers*	*Timeframe*	*Partners*
Rodney McKellip	SSC, GSFC	FY06 - FY07	

Earth Science Products

Other Apps.

Deliverables

Description	*End Date*	*IBPD Metric #*
Evaluation Report		
Design & Implement		
Verification and Validation Report		
Benchmark Report		

Notes:

<table>
<tr><td colspan="4">Project: Hyperspectral Research and Development for Invasive Species Fetection and Mapping</td><td colspan="2">Congressionally Mandated</td></tr>
<tr><td colspan="4" rowspan="2">Project will evaluate the use of airborne and space borne hyperspectral observations to monitor the distribution of specific noxious, non-native plants and their impact on agricultural, range and riparian lands in Nevada</td><td colspan="2">Budget ($K)

Procurement</td></tr>
<tr><td>FY06</td><td>0</td></tr>
<tr><td>Project Manager</td><td>Centers</td><td>Timeframe</td><td>Partners</td><td>FY07</td><td></td></tr>
<tr><td rowspan="3">Rodney McKellip</td><td rowspan="3">ARC, SSC</td><td rowspan="3">FY06 - FY06</td><td rowspan="3">DRI, University of Nevada</td><td>FY08</td><td></td></tr>
<tr><td>FY09</td><td></td></tr>
<tr><td>FY10</td><td></td></tr>
<tr><td>Earth Science Products</td><td colspan="3">Hyperion</td><td colspan="2">Other Apps.</td></tr>
<tr><td>Deliverables</td><td colspan="3"><u>Description</u> <u>End Date</u> <u>IBPD Metric #</u>
Evaluation Report
Design & Implement
Verification and Validation Report
Benchmark Report
Accuracy assessment
Establish up to 20 field data sites
Acquire field spectra
Acquire airborne data
Data analysis</td><td colspan="2"></td></tr>
<tr><td colspan="6">Notes: Program supported with FY05 funds for work in FY06</td></tr>
</table>

Project: SGU augmentation				Directed Project	
Additonal funds for SGU project to bring funding level to $250k				*Budget ($K)* *Procurement*	
				FY06	50
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	50
Karen Yuen	JPL, SSC	FY05 - FY09	USGS/EDC	FY08	50
				FY09	50
				FY10	
Earth Science Products				*Other Apps.*	
Deliverables	*Description* — *End Date* — *IBPD Metric #* Evaluation Report Design & Implement Verification and Validation Report Benchmark Report				
Notes: See SGU DST for project details					

Project: Program Element Team Meeting				Project Management	
Annual meeting to review and discuss program elements goals and objectives. Participants will include all funded PIs in the the propgram element and others.				*Budget ($K)*	
				Procurement	
				FY06	10
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	10
Ed Sheffner	ARC, SSC, GSFC, JPL, GISS, MSFC	FY06 - FY10	Univ. of Arizona and Univ. of Missouri	FY08	12
				FY09	12
				FY10	15
Earth Science Products				*Other Apps.*	
Deliverables	*Description* — Evaluation Report Design & Implement Verification and Validation Report Benchmark Report	*End Date*	*IBPD Metric #*		
Notes: Team meeting will be held in conjunction with ag efficiency and carbon management.					

<table>
<tr><td colspan="4">Project: SGU Project Management</td><td colspan="2">Project Management</td></tr>
<tr><td colspan="4" rowspan="4">NASA project management responsibility of SGU proposal</td><td colspan="2">Budget ($K)

Procurement</td></tr>
<tr><td>FY06</td><td>35</td></tr>
<tr><td>Project Manager</td><td>Centers</td><td>Timeframe</td><td>Partners</td><td>FY07</td><td>35</td></tr>
<tr><td rowspan="3"></td><td rowspan="3">JPL, SSC</td><td rowspan="3">FY05 - FY09</td><td rowspan="3"></td><td>FY08</td><td>35</td></tr>
<tr><td>FY09</td><td>35</td></tr>
<tr><td>FY10</td><td></td></tr>
<tr><td>Earth Science Products</td><td colspan="4"></td><td colspan="2">Other Apps.</td></tr>
<tr><td>Deliverables</td><td colspan="4"><u>Description</u> <u>End Date</u> <u>IBPD Metric #</u>
Evaluation Report
Design & Implement
Verification and Validation Report
Benchmark Report</td><td colspan="2"></td></tr>
<tr><td colspan="6">Notes:</td></tr>
</table>

<table>
<tr><td colspan="4">Project: Interagency activiities and coordination</td><td colspan="2">Project Management</td></tr>
<tr><td colspan="4" rowspan="2">Coordinate NASA invasive species projects and tasks with the NISC, ISAC, ITAP etc.,</td><td colspan="2">Budget ($K)

Procurement</td></tr>
<tr><td>FY06</td><td>5</td></tr>
<tr><td>Project Manager</td><td>Centers</td><td>Timeframe</td><td>Partners</td><td>FY07</td><td>5</td></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3">-</td><td rowspan="3"></td><td>FY08</td><td>5</td></tr>
<tr><td>FY09</td><td>5</td></tr>
<tr><td>FY10</td><td>5</td></tr>
<tr><td>Earth Science Products</td><td colspan="3"></td><td colspan="2">Other Apps.</td></tr>
<tr><td>Deliverables</td><td colspan="3"><u>Description</u> <u>End Date</u> <u>IBPD Metric #</u>
Evaluation Report
Design & Implement
Verification and Validation Report
Benchmark Report</td><td colspan="2"></td></tr>
<tr><td colspan="6">Notes:</td></tr>
</table>

Project: Conference Support				Project Management	
Co-sponsorship of conferences in which NASA contributions to invasive speices are discussed or presented.				*Budget ($K)* *Procurement*	
				FY06	5
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	5
Ed Sheffner		FY06 - FY10	Other NISC members	FY08	30
				FY09	30
				FY10	25
Earth Science Products				*Other Apps.*	
Deliverables	*Description* — Evaluation Report Design & Implement Verification and Validation Report Benchmark Report	*End Date*	*IBPD Metric #*		
Notes:					

Project: The Invasive Species Data Service: Towards Operational Use of Earth-Sun System Division Data in the USGS Invasive Species Decision				Solicitation	
Extends work underway with USGS/NIISS on the NISFS by improving access to NASA observation and data products (SeaWIFS, Landsat, Terra, Aqua, QuikSCAT, Jason) and data from commercial systems (Ikonos, Quickbird) for users to generate invasive species forecasting maps through the NISFS.				*Budget ($K)* *Procurement*	
				FY06	656
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	670
Rodney McKellip	GSFC, SSC	FY03 - FY07	USGS/NIISS, YERC, CSU	FY08	
				FY09	
				FY10	
Earth Science Products	MODIS, ASTER, AMSR, SRTM			*Other Apps.*	
Deliverables	*Description*	*End Date*	*IBPD Metric #*	Carbon management	
	Evaluation Report				
	Design & Implement				
	Verification and Validation Report				
	Benchmark Report	10/1/2006			
	Deliver ISFS releases 3 and 4	6/1/2006			
	ISFS early adaptor group sessions	9/1/2006			
	Enhance ISFS/ISAMS	6/1/2006			
	Integr. NPS,YERC projs into ISFS	6/1/2006			
Notes: REASoN CAN					

Project: Systems Integration and Visualization of Yellowstone: an Earth Systems Research, Application, and Education Solution				Solicitation	
Extends the scope of NASA collaboration through the use of the ìTarsierî modeling framework (ASTER, MODIS, SRTM Landsat and AVHRR data) for decisions on mitigation of invasive species.				*Budget ($K)* *Procurement*	
				FY06	373
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	100
Rodney Mckellip	GSFC	FY03 - FY07	NPS/YNP, CSUMB, Montans State U.	FY08	
				FY09	
				FY10	
Earth Science Products	ASTER, MODIS, SRTM, Landsat, and AVHRR			*Other Apps.*	
Deliverables	*Description*	*End Date*	*IBPD Metric #*		
	Evaluation Report				
	Design & Implement				
	Verification and Validation Report	8/1/2006			
	Benchmark Report	10/1/2006			
	Data & tool xfer to ORN DAAC	7/1/2006			
Notes: REASoN CAN					

Project: Using the Invasive Species Forecasting System to Support National Park Service Deicisions on Fire Management Activities and Invasive Plant				Solicitation	
Fire and invasive species are related and are major cause of ecological disturbance. This project will establish the relationship between fire and invaisve species in three national parks and enhance the decision making capabilities of park managers to control invasive species.				*Budget ($K)* *Procurement*	
				FY06	333
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	336
Rodney McKellip	GSFC	FY05 - FY07		FY08	
				FY09	
				FY10	
Earth Science Products	MODIS, ASTER, Hyperion			*Other Apps.*	
Deliverables	*Description*	*End Date*	*IBPD Metric #*	Carbon management, disaster management	
	Evaluation Report	3/1/2006			
	Design & Implement				
	Verification and Validation Report				
	Benchmark Report				
	Complete burnt area evaluation	9/1/2006			
	Baseline data compilation	5/1/2006			
Notes: Decisions solicitation Deliverables cont'd: Evaluate existing NPS capabilities in three parks by 3/1/2006					

<table>
<tr><td colspan="4">Project: Enhancing Tribal Rangeland Management</td><td colspan="2">Solicitation</td></tr>
<tr><td colspan="4" rowspan="2">Enhancement of decsion support tools employed by ther Rosebud Sioux Reservation to make management decisions regarding invasive species control and rangeland mangement.</td><td colspan="2">Budget ($K)

Procurement</td></tr>
<tr><td>FY06</td><td>200</td></tr>
<tr><td>Project Manager</td><td>Centers</td><td>Timeframe</td><td>Partners</td><td>FY07</td><td>200</td></tr>
<tr><td rowspan="3">Karen
Yuen</td><td rowspan="3">JPL, SSC</td><td rowspan="3">FY05 - FY09</td><td rowspan="3">Sinte Gleska U.
USGS, UMAC</td><td>FY08</td><td>200</td></tr>
<tr><td>FY09</td><td>200</td></tr>
<tr><td>FY10</td><td></td></tr>
<tr><td>Earth Science Products</td><td colspan="3">MODIS, ASTER, SRTM</td><td colspan="2">Other Apps.</td></tr>
<tr><td>Deliverables</td><td colspan="3"><u>Description</u> <u>End Date</u> <u>IBPD Metric #</u>
Evaluation Report 9/1/2006
Design & Implement
Verification and Validation Report
Benchmark Report</td><td colspan="2">Agricultural efficiency, carbon management</td></tr>
<tr><td colspan="6">Notes: REASoN CAN - late start</td></tr>
</table>

Project: New project(s) from ROSES solicitation				Solicitation	
New project(s) in invasive speices awarded through ROSES I solicitation				*Budget ($K)* *Procurement*	
				FY06	415
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	415
Ed Sheffner		-		FY08	415
				FY09	0
				FY10	0
Earth Science Products				*Other Apps.*	
Deliverables	*Description* Evaluation Report Design & Implement Verification and Validation Report Benchmark Report	*End Date*	*IBPD Metric #*		
Notes:					

E. Additional Activities & Linkages

Fellowships: NASA fellowships for the period 2002 through 2006 with potential impact on the Invasive Species Program Element:

Name: Isabel Ashton
Title: Biological invasions and alterations of the global carbon balance.
Institution: Stony Brook University

Name: Laura Koteen
Title: A Comparison of Carbon Cycling and Material Exchange in Landscapes Dominated by Native and Exotic Grasses in Northern Coastal California
Institution: University of California, Berkeley

E. IBS Request

NPS Fire and Invasive Species

YNP visualization products

Enanced ISFS

Program Response to IBS Request

To be supplied by program management.

E. Crosscutting Request

None.

Program Response to Crosscutting Request

To be supplied by program management.

VI. Budget: FY06-010

The following table lists the Public Health Program budget (procurement) for FY2006:

Project		FY06 Procurement Allocation ($K)
EPHTN/HELIX	$	463
Arbonet/Plague Surveillance System	$	380
Malaria/GSAT	$	265
DHHS SCC	$	110
PHAiRS/RSVP (REASoN)	$	700
Workshops, Conferences, etc.	$	50
Enhancing USAID Famine and Malaria Early Warning with NASA Earth Science Results (FEWS NET/MEWS)	$	467
Three Dimensional Air Quality System (3D-AQS)	$	0
GeoMedStat	$	0
Total =	$	**2435**

Appendix C lists program-wide budget allocations for FY2006-10.

VII. Program Management and Performance Measures

The Invasive Species Management Team uses performance measures to track progress, identify issues, evaluate projects, make adjustments, and establish results of the Program Element. The program's Goals and Objectives (Section II) state what the program intends to achieve. These measures help monitor progress within and across specific activities to ensure the Program meets its goals and objectives. The Management Team analyzes these measures retrospectively in order to made adjustments proscriptively to the Program approach and objectives.

The measures are in two categories. Program Management measures are internally focused to assess the activities within the Program. Performance measures are externally focused to assess if the Program activities are serving their intended purpose. In general, the Program Manager uses these measures to evaluate the performance of activities conducted and sponsored by the Program, especially the projects. In addition, the Applied Sciences Program uses this information in preparing IBPD directions and PART responses.

Project Management Measures (Internal):

Inputs:
1) Potential issues and DSTs identified for Invasive Species – number, type, range
2) Eligible partners to collaborate with – number, type, range
3) Potential results/products identified to serve Invasive Species – number, type, range

Outputs:
1) Assessments or evaluations of DSTs – number, range
2) Assessments of Earth-Sun science results/products to serve DSTs – number, range
3) Agreements with partners – presence
4) Reports (evaluation, validation, benchmark) – number, type

Quality and Efficiency:
1) Earth-Sun System science results/products – number used per DST, ratio of utilized to potential
2) Agreements – ratio of agreements to committed partners
3) Reports – partner satisfaction, timeliness, time to develop
4) Reports – ratio of validations to potential products, ratio of benchmarks to validations

Performance and Results Measures (Externally-focused):

Outcomes:
1) Earth-Sun System science products adopted in DSTs – number, type, range; use in DST over time
2) Earth-Sun System science products in use – ratio of products used by partners to reports produced
3) Partner and DST performance – change in partner DST performance, number and type of public recognition of use and value of Earth-Sun System science data in DST

Impacts:
1) Partner value – change in partner metrics (improvements in value of partner decisions)

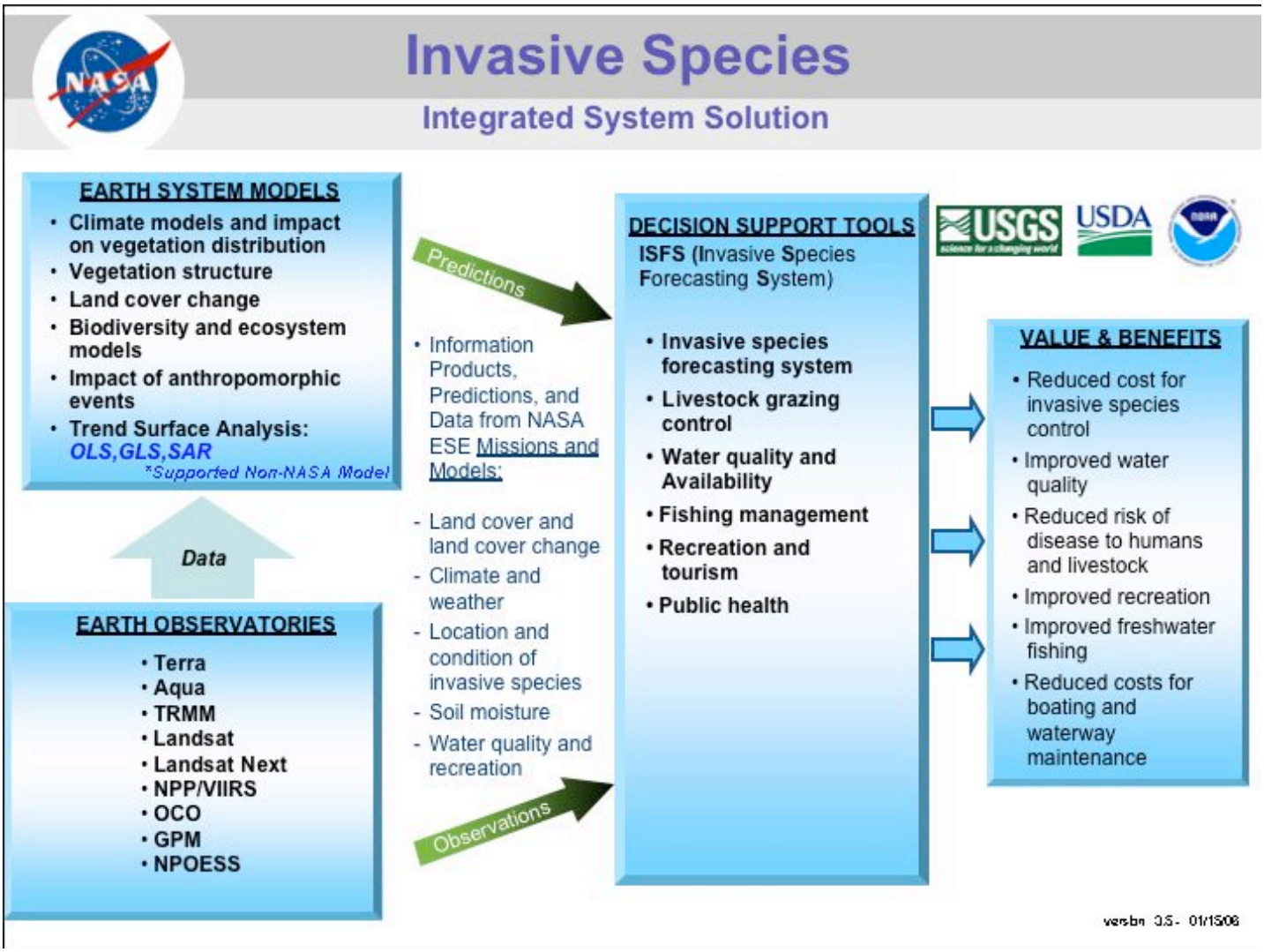
In addition to the stated measures, the Invasive Species Program Manager periodically requests an assessment of its

plans, goals, priorities, and activities through external review. The Invasive Species Program Element Team uses these measures along with comparisons to programmatic benchmarks to support assessments of the Applied Sciences Program (e.g. internal NASA reviews and OMB PART).

VIII. Appendicies

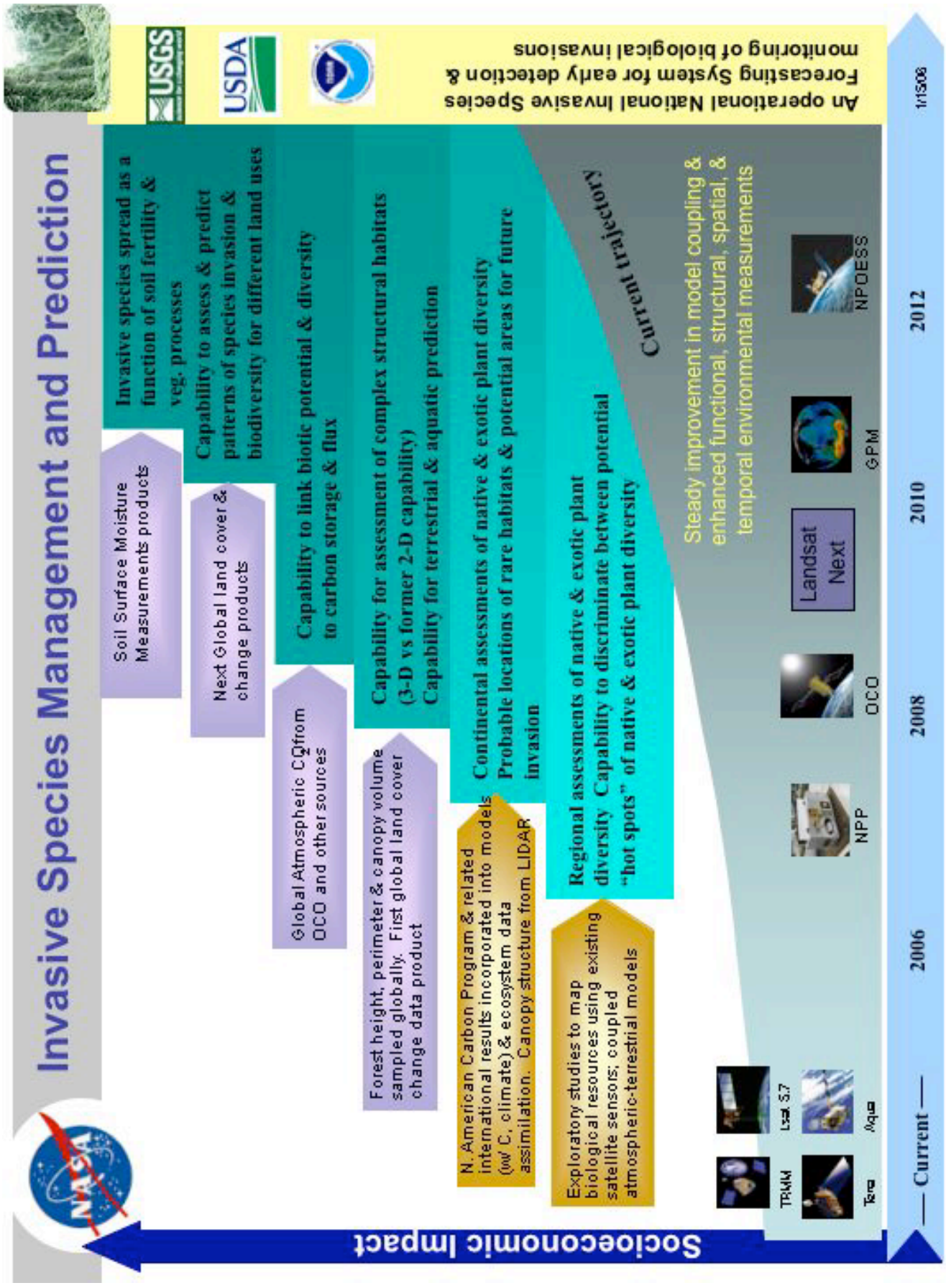
A. Integrated System Solutions Diagram

The figure below illustrates how Science measurements, model products, and data fusion techniques support the Invasive Species Program's partners and their decision support tools and shows the value and benefits of Science to society.



B. Roadmap

The Invasive Species Element roadmap illustrates how NASA capabilities in Earth observation, measurement, modeling and systems engineering are exploited systematically to improve the decision support systems and tools of USGS and other agencies and organizations making policy and resource decisions for invasive species. The roadmap focuses on NISFS, baselining current capabilities and benchmarking improvements as such improvements are integrated into the NISFS. The roadmap starts in FY04 with the integration and evaluation of MODIS products and NASA systems engineering. Beginning in FY05 and continuing in the out years, data from new systems will be evaluated, initially through simulations, then through analysis of the data when available. Several planned NASA Earth-Sun science missions have the potential to impact USGS decision support tools and systems. These missions include the Orbiting Carbon Observatory (OCO), Aquarius and Hydros. The OCO provides space-based observations of atmospheric carbon dioxide (CO2), the principal anthropogenic driver of climate change. This mission uses mature technologies to address NASA's highest priority carbon cycle measurement requirement. The OCO generates the knowledge needed to improve projections of future atmospheric CO2. The mission is relevant to invasive species because of the impact of climate change on invasive species habitat. Invasive species may also have to be considered in Carbon Management issues such as the sequestration of carbon in above ground biomass. Aquarius is a focused spacecraft mission to measure global sea surface salinity (SSS). Aquarius will resolve missing physical processes that link the water cycle, the climate, and the ocean. The Aquarius science goals are to observe and model the processes that relate salinity variations to climatic changes in the global cycling of water and to understand how these variations influence the general ocean circulation. The Hydrosphere State Mission (Hydros) will provide the first global views of Earth's changing soil moisture and land surface freeze/thaw conditions, leading to breakthroughs in weather and climate prediction and in the understanding of processes linking water, energy, and carbon cycles. The Roadmap shows the major events in the chronology toward evaluation of these sources of observations and the progression of the data toward improved decision support systems and tools over the next ten years.


Invasive Species Management and Prediction
An operational National Invasive Species Forecasting System for early detection & monitoring of biological invasions
USGS
USDA
Soil Surface Moisture Measurements products
Next Global land cover & change products
Global Atmospheric CO2 from OCO and other sources
Forest height, perimeter & canopy volume sampled globally. First global land cover change data product
N. American Carbon Program & related international results incorporated into models (w/ C, climate) & ecosystem data assimilation. Canopy structure from LIDAR
Exploratory studies to map biological resources using existing satellite sensors; coupled atmospheric-terrestrial models
Invasive species spread as a function of soil fertility & veg. processes
Capability to assess & predict patterns of species invasion & biodiversity for different land uses
Capability to link biotic potential & diversity to carbon storage & flux
Capability for assessment of complex structural habitats (3-D vs former 2-D capability)
Capability for terrestrial & aquatic prediction
Continental assessments of native & exotic plant diversity
Probable locations of rare habitats & potential areas for future invasion
Regional assessments of native & exotic plant diversity Capability to discriminate between potential "hot spots" of native & exotic plant diversity
Current trajectory
Steady improvement in model coupling & enhanced functional, structural, spatial, & temporal environmental measurements
Landsat Next
TRMM
Terra
Aqua
Land 5,7
NPP
OCO
GPM
NPOESS
Socioeconomic Impact
Current
2006
2008
2010
2012
1/15/08

C. Applied Sciences Program Budgets FY2006-10

The following figures represent the FY06 budgets for the respective Program Elements; they do not represent the entire Applied Sciences Program budget. There is an additional $8.95million in Congressionally-directed activities and $5million for the Mississippi Research Consortium that these figures do not incorporate.

Program Element	FY06 Procurement Allocation
National Applications	
Agricultural Efficiency	$ 1,955,803
Air Quality	$ 3,116,464
Aviation	$ 3,048,878
Carbon Management	$ 1,544,831
Coastal Management	$ 1,416,233
Disaster Management	$ 2,743,760
Ecological Forecasting	$ 3,240,170
Energy Management	$ 1,875,253
Homeland Security	$ 1,987,054
Invasive Species	$ 2,241,940
Public Health	$ 3,356,124
Water Management	$ 1,714,341
Crosscutting Solutions	
DEVELOP	$ 1,498,000
Geospatial Interoperability	$ 2,400,000
Solutions Networks	$ 2,822,000
Integrated Benchmarking System	$ 4,500,000

The following figures show the five-year run-out for the entire Applied Sciences Program. The figures are based on the FY07 President's budget submitted to Congress. The lower line shows the target budget including agency corporate and institutional adjustments.

	2006	2007	2008	2009	2010
Present Budget Summited to Congress	53,254,855	51,049,000	50,287,000	48,588,000	48,662,000
Target After Adjustments	47,321,663	39,101,000	33,922,000	34,801,000	34,803,000

D. Related NASA and Partner Solicitations and Grants

Appendix D lists NASA Earth-Sun system science research projects, Earth science fellowships, GLOBE activities, and Earth science New Investigators related to Invasive Species activities.

Institution	*PI*	*Title/Subject*	*Timeframe*
None		None Listed	

E. Acronyms and Websites

ACRONYMS:

ACRIM	Active Cavity Radiometer Irradiance Monitor Satellite
AGU	American Geophysical Union
AIWG	Applications Implementation Working Group
ALI	Advanced Land Imager
ARC	Ames Research Center
ASTER	Advanced Spaceborne Thermal Emission and Reflectance Radiometer
AVHRR	Advanced Very High Resolution Radiometer
CCSP	Climate Change Science Program
CCTP	Climate Change Technology Program
CO2	Carbon Dioxide
COTR	Contracting Officer's Technical Representative
DOI	Department of the Interior
DSS	Decision Support Systems
DST	Decision Support Tool
ECHO	Earth observing system Clearing House
EO-1	Earth Observing-1
EOS	Earth Observing Systems
ESG	Earth-Sun Gateway
FEA	Federal Enterprise Architecture
FY	Fiscal Year
GIG	Global Information Grid
GIS	Geographic Information System
GSFC	Goddard Space Flight Center
IBPD	Integrated Budget and Performance Document
ISAMS	Improved Stratospheric and Mesospheric Sounder
ISFS	Invasive Species Forecasting System
IWGEO	Interagency Working Group on Earth Observations
JCSDA	Joint Center for Satellite Data Assimilation
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MR1	Portable Side Scan Seafloor Imaging System
MSU	Mississippi State University
NASA HQ	NASA Headquarters
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NESDIS	National Environmental Satellite Data Information Service
NIISS	National Institute of Invasive Species Science
NISFS	National Invasive Species Forecasting System
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRA	NASA Research Announcement

NSF	National Science Foundation
NWS	National Weather Service
OCO	Orbiting Carbon Observatory
OMB	Office of Management and Budget
OSSE	Observing System Simulation Experiment
OSTP	Office of Science and Technology Policy
QA	Quality Assurance
QuikSCAT	Quick Scatterometer
R2O	Research to Operations Network
REASoN	Research, Education, and Applications Solutions Network
SEA	State Enterprise Architecture
SeaWiFS	Sea-viewing Wide-Field-of-View Sensor
SRTM	Shuttle Radar Topography Mission
SSC	Stennis Space Center
SSS	Sea surface salinity
TAR	Temporal Analysis Research
USDA	US Department of Agriculture
USGS	United States Geological Survey
V&V	Verification and Validation

WEBSITES:

AIWG: http://aiwg.gsfc.nasa.gov
Applied Sciences Program: http://science.hq.nasa.gov/earth-sun/applications
DEVELOP: http://develop.larc.nasa.gov
Earth-Sun System Gateway (ESG): http://esg.gsfc.nasa.gov/
Earth-Sun Science System Components: http://www.asd.ssc.nasa.gov/m2m
NASA FY2005 Budget: http://www.ifmp.nasa.gov/codeb/budget2005
Research and Analysis Program: http://science.hq.nasa.gov/earth-sun/science/
Science Mission Directorate: http://science.hq.nasa.gov
Science Strategies: http://science.hq/nasa.gov/strategy/